本試題卷共有單選題 20 題，每題 5 分。

1. A police car moves with a speed v_s in the same direction as a truck that has a speed v_c. The frequency of police's siren is f. What is the frequency heard by the truck driver when the police car is behind the truck? Take the sound speed to be v.

   (A) $\left(\dfrac{v-v_c}{v-v_s}\right)f$　(B) $\left(\dfrac{v+v_c}{v-v_s}\right)f$　(C) $\left(\dfrac{v-v_s}{v+v_c}\right)f$　(D) $\left(\dfrac{v+v_c}{v+v_s}\right)f$　(E) $\left(\dfrac{v-v_s}{v-v_c}\right)f$

2. Suppose a spring is massless, and it behaves well without exceeding the elastic limit (Hooke's law). One end of the spring is fixed at the center of a frictionless table. The other end of the spring is attached to a point solid ball of finite mass. This ball is in uniform circular motion around the center of the table. Which one of the following descriptions is true?

   (A) The square of the period of the ball is proportional to the cube of its distance from the center of the table.

   (B) The length of the spring is proportional to the speed of the ball.

   (C) The line joining the ball to the center of the table sweeps out equal areas in equal times.

   (D) The force acting on the ball is inversely proportional to the distance from the ball to the center of the table.

   (E) The point solid ball is in translational equilibrium, since its speed is constant.

3. The gas pressure in a cubical box filled with oxygen is 1×10^{-10} Pa at 300 K. The length of each side of the box is 1 cm. What is the collision rate of the oxygen on one of the box surfaces? ($R = 8.31$ J/mol·K , molar mass of oxygen is 32 g)

   (A) 8×10^{10} Hz　(B) 2×10^{-5} Hz (C) 3 Hz　(D) 8×10^{3} Hz　(E) 2×10^{5} Hz .

4. A continuous sinusoidal transverse wave is traveling on a string. The maximum transverse speed of the string is 20% of the propagation speed of the wave. What is the maximum transverse displacement, in terms of the wave length of the wave?

   (A) 10λ　(B) $5\lambda/\pi$　(C) $\pi\lambda/5$　(D) $\lambda/(20\pi)$　(E) $\lambda/(10\pi)$

5. A cubical block of wood of edge length 10 cm floats at the interface between oil and water. The bottom of the block is 4 cm below the interface. The density of the oil is 0.6 gm/cm^3. What is the mass of the block?

   (A) 480 g　(B) 600 g　(C) 680 g　(D) 760 g　(E) 550 g .
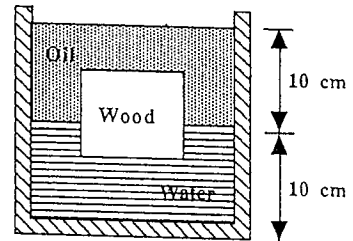
6. Isaac Newton was NOT inspired by the falling apple on his head. Actually, it was striking his stomach when he lay down. This apple was bounced back and upward straightly, and it lost 19% of its kinetic energy during the interaction. How high would the apple rise after the first bounce if it originally fell from a branch at a height of one meter? (Answers in meters)

   (A) 1.0　(B) 0.65　(C) 0.90　(D) 0.81　(E) 0.19 .

7. A space ship is far from the solar system and has a large communication dish. It travels with velocity to the right of 100 ms^{-1}. The ship, dish and fuel have a mass of 1000 kg. The ship encounters a shower of sticky meteorites of average mass 0.01 kg traveling with velocity of 200 ms^{-1} to the left. There are 1000 meteorites per second hit the dish and stick to it. As the first meteorite strikes the dish, the rocket engines are fired to eject 10 kg of fuel per second at a velocity relative to the ship of 500 ms^{-1} to the left. Calculate the acceleration of the ship at that instant.

   (A) 3 ms^{-2} right　(B) 2 ms^{-2} right　(C) 3 ms^{-2} left　(D) 1 ms^{-2} left　(E) 1 ms^{-2} right

8. As shown in the figure, the inner lengths of a rectangular brass frame are x and y, and the width is z. The rotational inertia of the frame along the axis is I. If the frame temperature raises from 0°C to 150°C, then :

   (A) x will increase and I will decrease　(B) both x and I will increase　(C) y will decrease and I will increase　(D) both x and I will decrease　(E) depends on z
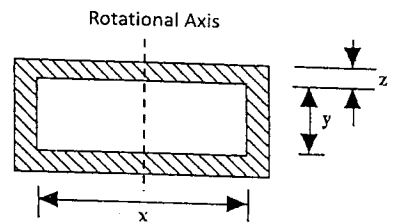
9. The temperature of low pressure hydrogen is reduced from 100℃ to 20℃. The root mean square (rms) speed of its molecules decreases by approximately: (A) 80 %　(B) 89 %　(C) 11 %　(D) 21 %　(E) 46 %

10. Choose the correct statement concerning electric fields:

    (A) electric field lines may cross　(B) The electric field induced by a moving charge can be correctly calculated by using the

Coulomb's law   (C) an electric dipole experiences a net force due to a uniform electric field   (D) a point charge q, released from rest, will move along a line of electric field   (E) none of these

11. A battery is used to charge a parallel-plate capacitor, after which it is disconnected. Then the plates are pulled apart to twice their original separation. This process will double the

    (A) capacitance   (B) surface charge density on each plate   (C) stored energy   (D) electric field between the two places (E) charge on each plate

12. Electrons (mass m, charge $-e$) are accelerated from rest through a potential difference V and are then deflected by a magnetic field B that is perpendicular to their velocity. The radius of the resulting electron trajectory is:

    (A) $\sqrt{2eV/m}\big/B$ (B) $B\sqrt{2meV}$ (C) $\sqrt{2mV/e}\big/B$ (D) $B\sqrt{2mV/e}$ (E) none of these

13. An "electron volt" is :

    (A) force acting on an electron in a field of 1 N/C ;   (B) force required to move an electron 1 meter ;   (C) energy needed to move an electron through 1 meter in any electric field ;   (D) energy gained by an electron in moving through a potential difference of 1 volt ;   (E) work done when 1 coulomb of charge is moved through a potential difference of 1 volt .

14. Evidence that electromagnetic waves have momentum is:

    (A) the tail of a comet points away from the sun ;   (B) electron flow through a wire generates heat ;   (C) a charged particle in a $\vec{B}$ field moves in a circular orbit ;   (D) heat can be generated by rubbing two sticks together ;   (E) the Doppler effect .

15. A level glass-bottomed tank contains liquid as shown. A beam of light is incident at angle θ on the upper liquid surface. Select the largest value for θ in degrees given below which permits this light to leave through the bottom glass-air surface.

    (A) 89 ;   (B) 56 ;   (C) 48 ;   (D) 38 ;   (E) 21 .

Air	n = 1.0	θ
Liquid	n = 1.2	
Glass	n = 1.6	
Air	n = 1.0	

16. A camera lens is 50 mm from the film plane. The lens focuses the light from two distant point sources so that the centers of their diffraction patterns are separated by 0.025 mm, Find the smallest diameter of lens aperture in mm that allows these two images to be resolved in the visible wavelength range (400 nm $\leqq \lambda \leqq$ 700 nm).

    (A) 0.80 ;   (B) 1.7 ;   (C) 1.4 ;   (D) 0.85 ;   (E) 0.98 .

17. Quasar Q_1 is moving away from us at a speed of 0.8 C. Quasar Q_2 is moving away from us in the opposite direction at a speed of 0.5 C. The speed of Q_1 as measured by an observer on Q_2 is: ("C" is the speed of light)

    (A) 0.3 C ;   (B) 0.65 C ;   (C) 0.93 C ;   (D) 1.0 C ;   (E) 1.3 C .

18. When the principal quantum number of hydrogen atom is $n = 3$, how many different values of orbital quantum number ℓ and orbital magnetic quantum number m_ℓ are possible?

    (A) three values (0, 1, 2) of ℓ , five values (-2, -1, 0, 1, 2) of m_ℓ ;   (B) three values (1, 2, 3) of ℓ , five values (-2, -1, 0, 1, 2) of m_ℓ ;   (C) three values (0, 1, 2) of ℓ , five values (-3/2, -1/2, 0, 1/2, 3/2) of m_ℓ ;   (D) five values (-2, -1, 0, 1, 2) of ℓ , five values (-3/2, -1/2, 0, 1/2, 3/2) of m_ℓ ;   (E) three values (1, 2, 3) of ℓ , seven values (-5/2, -3/2, -1/2, 0, 1/2, 3/2, 5/2) of m_ℓ .

19. The quantization of energy, $E = nh\nu$, is not important for an ordinary pendulum because:

    (A) the formula applies only to mass-spring oscillators ;   (B) the allowed energy levels are too closely spaced ;   (C) the allowed energy levels are too widely spaced ;   (D) the formula applies only to atoms ;   (E) the value of h for a pendulum is too large .

20. An electron is trapped in a deep potential well. As the well dimension decreases, the energy of the ground state increases. This is in agreement with:

    (A) the uncertainty principle ;   (B) the complementary principle ;   (C) conservation of energy ;   (D) conservation of angular momentum ;   (E) tunneling .

注意：背面有試題